cial Publication 12

August 1985

ECON: A System for Economic Analysis with a Programmable Calculator

Norman E. Elwood
Jonna C. Kincaid

College of Forestry **Oregon State University**

The Forest Research Laboratory of Oregon State University was established by the Oregon Legislature to conduct research leading to expanded forest yields, increased use of forest products, and accelerated economic development of the State. Its scientists conduct this research in laboratories and forests administered by the University and cooperating agencies and industries throughout Oregon. Research results are made available to potential users through the University's educational programs and through Laboratory publications such as this, which are directed as appropriate to forest landowners and managers, manufacturers and users of forest products, leaders of government and industry, the scientific community, and the general public.

The Authors

Norman E. Elwood and Jonna C. Kincaid are, respectively, forest management extension specialist and senior research assistant, Department of Forest Management, College of Forestry, Oregon State University, Corvallis.

Disclaimer

The mention of trade names or commercial products in this publication does not constitute endorsement or recommendation for use.

To Order Copies

Copies of this and other Forest Research Laboratory publications are available from:

Forestry Business Office
College of Forestry
Oregon State University
Corvallis, Oregon 97331

Please include author(s), title, and publication number if known.

ECON: A System for Economic Analysis with a Programmable Calculator

Norman E. Elwood
Jonna C. Kincaid

Contents

Preface

Economic analysis of investments is an important phase in financial decision making. During a time of restricted budgets, it has become increasingly important to evaluate investments thoroughly before they are undertaken. Program ECON is a financial-analysis model developed for that purpose. Its primary aim is to aid resource managers in economic analysis of forestry projects, but it can serve equally well as a general-purpose tool for evaluation of nonforestry projects.

This manual is published to assist users in the operation of the program. It presumes that they have a basic understanding of project and economic analysis or will have access to background information in the Extension Service publications listed in the section, "Additional Sources of Information," page 14. The analyses in the section "Running Procedure" are designed to illustrate program features and operation and are not examples from actual projects.

Introduction

ECON, a general-purpose financial analysis program, was designed to aid investment analysis by generating several measures of economic profitability. It will help answer these questions:

> With a given set of knowns and assumptions, what is the financial outlook for an investment?
>
> How might expectations of profitability change if the basic investment situation changes?

The standard measures of economic profitability that ECON calculates are:

> Net present worth (NPW)
> Net future worth (NFW)
> Infinite series NPW
> Benefit-cost ratio (B/C)
> Realizable rate of return (RRR)

ECON accommodates inflation and unit-price changes and provides ample information for sensitivity testing. It accommodates an investment for any time span having 24 or fewer cash flows, provided that the user can identify the costs, returns, and timing of each. A special entry, the YIELD cash flow, saves the preliminary calculation of multiplying product yield by unit price to determine dollar return.

ECON was written in general terms, but because the primary applications are likely to be forestry projects, you may wish to translate the general terms to forestry terms like this:

General	Forestry
Investment period	Rotation
Infinite series NPW	Soil expectation value
Unit price % increase	Real timber price increase
No. units	Timber volume cut
$ Price	Timber price

How the Program Works

Before running ECON, you should recognize its general constraints:

> ECON accommodates a maximum of 24 cash flows.
>
> Running ECON on an HP-41C requires a quad memory module.
>
> ECON's size requires that you erase all programs previously stored in the calculator memory. Save needed programs on magnetic cards before attempting to load ECON.

Specific limitations, and the assumptions underlying program operation, are discussed with the topics that follow.

Investment Period

The investment period may be designated in any convenient unit (year, month, etc.). However, the associated rates of interest, inflation, and reinvestment must be expressed in the same unit: years require annual rates and months monthly rates. When you are using a time base other than a year, rescale annual costs accordingly.

Start the investment period at time zero even if you are dealing with an existing forest stand or another such long-standing investment (Figure 1). When responding to the prompt YEAR?, you must use a digit representing the year within the investment framework (e.g., "45" for the 45th year of a 60-year investment). Do not use the calendar year.

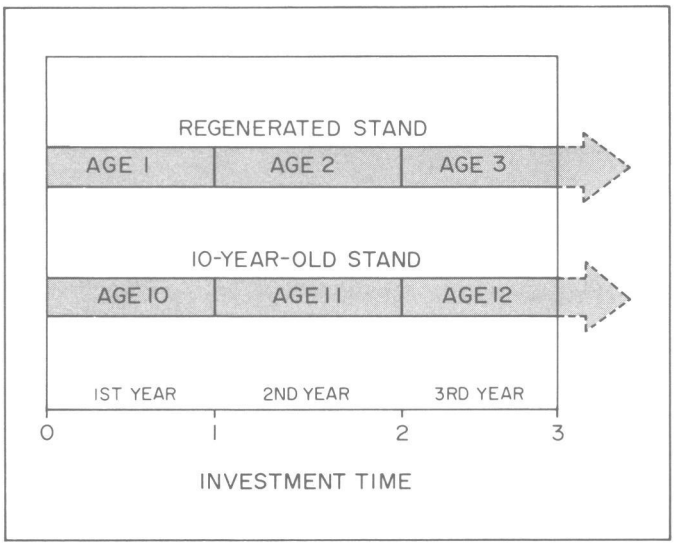


FIGURE 1.

THE INVESTMENT TIME FOR ECON BEGINS AT TIME ZERO REGARDLESS OF STAND AGE.

Interest and Inflation

ECON requires that you declare interest and inflation rates separately. You may use any positive rate, but ECON will accept rates only to the nearest tenth of a percent. Enter percentages rather than proportions (i.e., 8.5 rather than .085 for 8½%).

Interest rates will include inflation, which can be excluded simply by entering 0% inflation rate.

All dollar costs, returns, and unit prices should be entered in today's terms (current dollars).

Once an inflation rate is entered, all subsequent cash flow calculations, interest rates, and economic criteria will include that inflation rate (including 0% inflation).

Inflation is assumed to apply equally to costs and prices.

Annual Costs

Handling annual costs on a year-by-year basis would quickly exhaust calculator storage capacity. Therefore, since such costs are generally predictably constant, ECON allows their entry over each of two segments of an investment period. You merely enter each cost and the duration for which it applies. For example, a $10 annual cost might be entered for the first 30 years of a 60-year investment and a $5 annual cost for the remainder of the investment (Figure 2). The duration of the segments is completely flexible (the first segment could just as well be 1 year long and the second 59 years long, or vice versa), but note that ECON forces the end of the second segment to coincide with the end of the investment period.

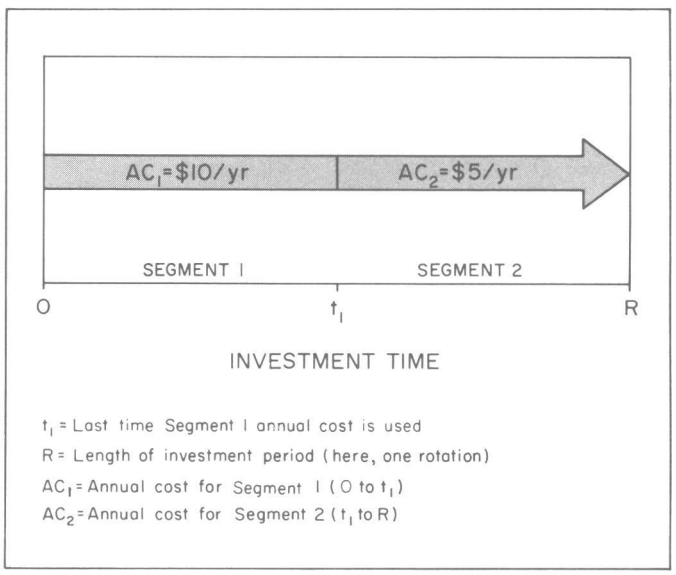


FIGURE 2.

ANNUAL COSTS MAY BE APPLIED AT A CONSTANT RATE FOR EACH OF TWO SEGMENTS OF THE INVESTMENT PERIOD.

Conventions differ regarding the time annual costs come due. ECON is programmed to assess them at the beginning of each year. You may enter annual costs in dollars and cents, but ECON rounds them to the nearest whole-dollar amount before calculation. Do not enter negative annual costs to simulate annual returns (results will be erroneous).

ECON is programmed to apply inflation to the compounding and discounting of annual costs for the entire investment period.

To facilitate sensitivity analysis, ECON calculates and reports annual costs separately from other cash flows.

Unit Prices

As unit price may fluctuate within an investment period, ECON accommodates changes over three segments of any length (Figure 3). You needn't use all three, but rates of change must be constant over each one. Note that ECON forces the end of the third segment to coincide with the end of the investment period.

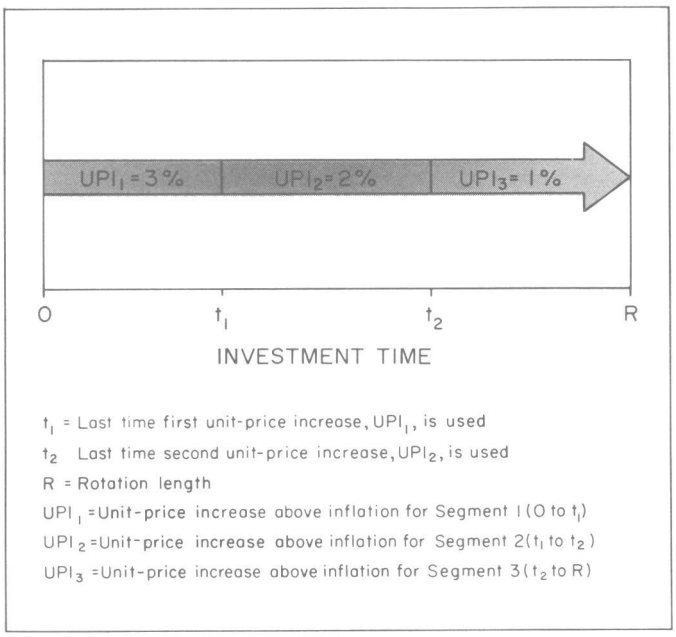


FIGURE 3.

UNIT-PRICE CHANGES MAY BE APPLIED AT A CONSTANT RATE FOR EACH OF THREE SEGMENTS OF THE INVESTMENT PERIOD.

The rates of change, specified as a percentage, are considered to be over and above the inflation rate already entered. Hence, with 6% inflation and a 2% unit-price increase, the change in unit price from one period to the next would be about 8% {100*[(1.06)*(1.02)-1]}. You may enter price change rates to the nearest 0.1%. Do not enter negative values for unit price change to simulate price deflation.

Cash Flows

ECON uses three kinds of cash-flow entries, COST, RETURN, and YIELD. (See Appendix, page 14, for dollar-magnitude limitation.) The first two, COST and RETURN, are applicable to any investment. Cost cash flows result from transactions involving costs alone, or those in which costs exceed returns. Return cash flows result from transactions involving returns alone, or those in which returns exceed costs.

The third cash flow, YIELD, applies specifically to production transactions using units produced and unit prices. The dollar amount generated by a yield calculation represents the product of the quantity produced and the price per unit at the time of transaction (current price compounded by unit-price increase and inflation factors). The units for prices-per-unit and volume must correspond in YIELD cash flows. ECON cannot screen for mismatched units.

Cost and return entries require only the whole-dollar amount and the year of the transaction. You may enter dollars and cents, but remember that ECON rounds values to the nearest whole dollar before calculation. All costs and prices should be entered in terms of what you would currently pay or receive. The program calculates the future value of each transaction with the rates of inflation, interest, and price increase already specified.

You may enter cost, return, and yield cash flows in any order. ECON will calculate the correct summary statistics. (Note, however, that it cannot reorder them for you. The sequence of input will be the sequence of output.) You may also enter cost and return cash flows for the same year. ECON will incorporate the correct net cash flow into the summary statistics.

Because ECON uses net cash flows in calculations of economic criteria, it allows maximum flexibility for designating the time when costs (other than the annual costs described earlier) and returns are incurred. For example, you may choose to have costs occur at the beginning of the year and returns at the end or to have both occur at the end of the year (Figure 4). Note that net cash flow (N_1) equals R_1-C_2 with costs incurred at the beginning of the year, but R_1-C_1 with costs incurred at the end. Such differences are easily accommodated when net cash flows are entered rather than separate costs and returns. Occasionally, the use of separate costs and returns is more appropriate. When costs are increasing by the rate of inflation and unit prices by inflation plus an additional real percentage, enter costs separately for greatest accuracy. ECON will apply the correct increase factor to each cash flow and correctly compute the net cash flow.

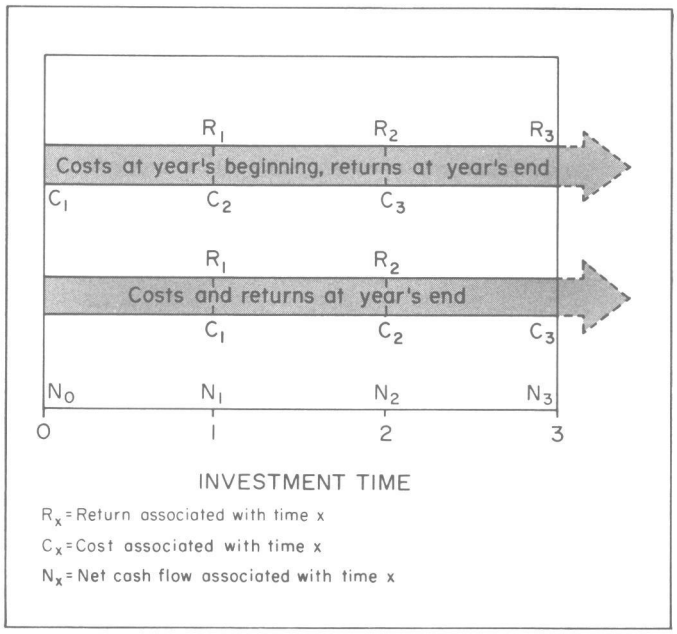


FIGURE 4.

ECON ALLOWS ENTRY OF CASH FLOWS AT THE BEGINNING OR END OF THE YEAR.

Reinvestment

ECON allows you to test project performance under different reinvestment strategies simply by rerunning the analysis with different reinvestment rates. Each rate is assumed to include the previously entered inflation rate. The program calculates the RRR, giving you control over the rate at which intermediate incomes are reinvested. Because it is unlikely that you will let intermediate project incomes remain idle, that money is assumed to have been reinvested at the specified reinvestment rate. The rate should reflect your best estimate of the money's earning power when it is reinvested. The rate can be above, equal to, or below the rate of interest that you use in the analysis. The reinvestment assumption for RRR differs from that for the classic internal rate of return (IRR), which assumes that all intermediate incomes are automatically reinvested at the same rate as the IRR.

Using ECON

Information Needed

What information is needed to run the program? You'll need to know:

- the length of the investment period (forestry applications may define the investment period as a rotation, for convenience, but any length of investment, whether an entire rotation or not, can be analyzed)
- the rate of interest you'll pay to borrow money
- the rate of interest at which you can reinvest intermediate project incomes
- whether inflation will be included- and, if so, its rate
- how unit prices change in relation to inflation.

For each cash-flow transaction, you'll need to know:

- the year of the transaction
- the costs or returns involved or the number of units produced and unit prices expected.

Printout Format

Appearing first in the program output is an input echo (Figure 5) that shows in compact form the data being used to evaluate your investment. The cash-flows section shows the time of each transaction and net value, including inflation and price increase. Next come each contribution to future value, the summation of costs and returns over the investment period, and the net future value. Present values are displayed in the same format; then other economic criteria.

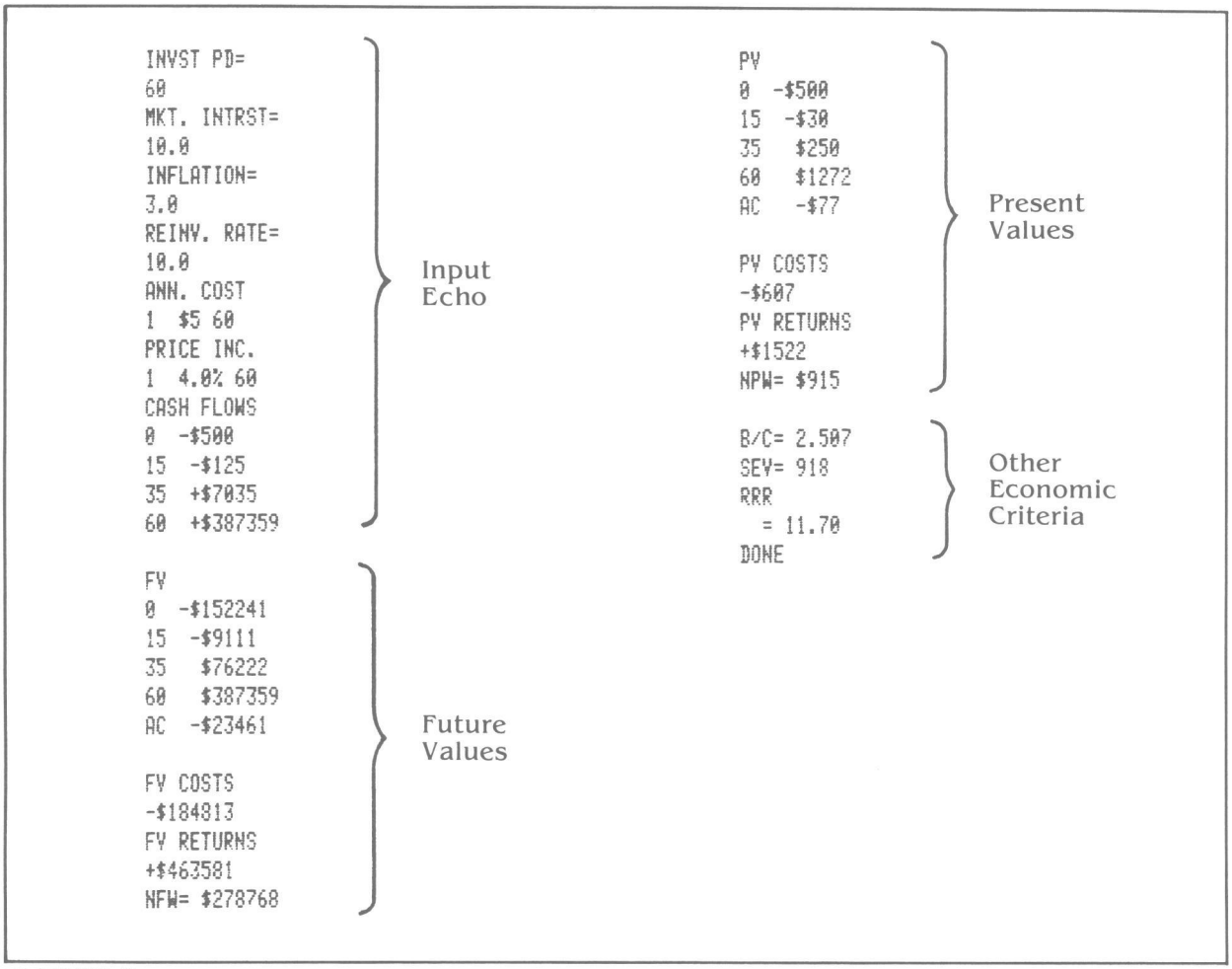


FIGURE 5.

AN EXAMPLE OF ECON OUTPUT BRACKETED TO SHOW THE ORDER OF INFORMATION DISPLAYED.

The Calculator

System Configuration

ECON may be used with either of two Hewlett-Packard (HP) programmable calculators in the following port configurations.

HP 41-C

1 Quad memory module	2
3 Printer	4 Card reader

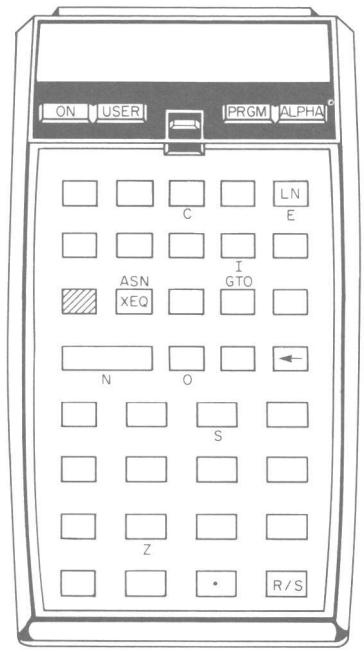
HP 41-CV

1	2
3 Printer	4 Card reader

The program listing (see Appendix) can be translated to other languages by an experienced programmer.

Key Reference

[▨]	Gold shift key (selects alternate functions)
XEQ	Execute key
LN	Natural logarithm key
ASN	Assign key
[▨]GTO	Shift and "Go to" keys
[▨]R/S	Shift and Run/stop keys
ALPHA	ALPHA mode toggle switch
PRGM	PROGRAM mode toggle switch
[•]	Period (decimal point) key
[←]	Correction key
S I Z E	The size function (spelled letter by letter with the calculator in ALPHA mode)



Loading Procedure

Before loading ECON, store programs that you want to save by copying them to magnetic cards. Then, erase all programs stored in the calculator (a necessity because of ECON's length) by turning the calculator off, depressing the correction key (←) while turning the calculator on, and releasing the correction key. The display should read MEMORY LOST. If not, try again.

Prepare the calculator data and storage registers to accommodate ECON:

Key XEQ ALPHA S I Z E ALPHA. (The calculator will display S I Z E _ _ _.)

Key 050. (The calculator will display 0.0000.)

You are now ready to load the 12 programs that make up ECON. YOU MUST NOT BE IN PROGRAM MODE. If PRGM is displayed, press the PRGM toggle switch to turn off program mode.

Key GOLD GTO [•] [•]

To read the cards, insert the first side. (The calculator will display RDY 02 OF 17, the number of sides in the program.) Turn the card and insert the second side. Continue in this manner until you've loaded all 17 sides. (The calculator will display WORKING and then 0.0000.)

Key GOLD GTO [•] [•] (The calculator will display PACKING and then 0.0000.)

Assign the command for the calculator to execute ECON to LN. (This will save much button pushing.)

Key GOLD ASN ALPHA E C O N ALPHA. (The calculator will display ASN ECON _.)

Key LN. (The calculator quickly displays ASN ECON 15, indicating that the command to execute ECON has been assigned to the LN key. ECON will remain so assigned until you cancel the assignment or erase the program.)

Checking Program Storage

Ensure that all 12 programs are properly stored. First, hook up your printer if you have one. MAKE SURE THAT BOTH THE CALCULATOR AND PRINTER ARE OFF BEFORE PLUGGING OR UNPLUGGING A PRINTER. Turn the printer on and put it into TRACE mode. Turn the calculator on.

```
LBL'ECON
LBL'AC
LBL'UP
LBL'CF
LBL'PAC
LBL'PUP
LBL'PCF
LBL'RT
LBL'FV
LBL'CDA
LBL'PT
LBL'PV
END          1875 BYTES
.END.        00 BYTES
```

Key GOLD CATALOG 1. With the printer, all programs stored in the calculator memory will be listed. Without a printer, the list will appear quickly in the display window. If your loading procedure was correct, the 12 programs in the master list shown here will appear. Their combined byte length should be the same as that listed (1,875 bytes).

Several types of errors can occur when you load a program. The calculator will display messages about each. Consult the Owner's Manual for the HP 41-C Card Reader to interpret the messages and recover from each error. When the CATALOG 1 listing matches the master list, you are ready to run ECON.

Operating with a Printer

Make sure that both the calculator and printer are off. Hook up the printer as shown in the system configuration diagram. Put the printer in NORMAL mode, turn on, and proceed with Example 1 below.

Operating without a Printer

Without a printer, ECON will do everything except advance the program from line to line. You must advance lines by keying R/S. All prompts are answered in the same way as they are with a printer, but results appear on the calculator display rather than on a printout.

Use Example 1 on this page to guide you through the program steps and prompts. When the calculator wants information, it will display a question mark. When you initiate ECON, the first display is LENGTH OF; you must key R/S for the rest of the prompt, INVST PD? You will then be at step 2. Complete it as shown and proceed to step 3. At step 4, you'll again get only the first line of the prompt, RATE OF; key R/S for the second line, INFLATION?, and respond as instructed. Proceed in this manner through the program. Other than the manual advancing of lines, all operations are the same as with a printer.

Running Procedure

ECON prompts for information with conversational language. When you are prompted for numeric data, you must enter something; if you key R/S only, you will get erroneous results. However, when you are prompted for alpha responses (e.g., YES or NO), you may use R/S in place of the positive response (i.e., you may respond to OK? with YES R/S or with R/S alone).

A reminder: ECON rounds all dollar entries to the nearest dollar. Percentage rates (interest, inflation, reinvestment, price increase) are rounded to the nearest 0.1%.

Startup

Turn on the calculator. Switch out of PROGRAM mode or ALPHA mode if they're on. Key XEQ ALPHA E C O N ALPHA, or if you are in USER mode, key the assigned function.

ECON Example 1: A Simple Problem

The following example gives results of analysis of a 60-year forestry investment. It is designed to illustrate major features of ECON and is not from an actual project. Interest and reinvestment rates in the example are 10%, and the inflation rate is 3%. Annual costs are constant, but unit-price adjustments (here, timber price) exceed inflation. All three types of cash flows are shown (COST, RETURN, and YIELD). The annotated numbers explain each program entry.

```
                XEQ "ECON"
1     LENGTH OF
      INVST PD?
                60    RUN
2     INTRST RATE?
              10.0    RUN
3     RATE OF
      INFLATION?
               3.0    RUN
4     RATE OF
      REINVST.?
              10.0    RUN
5     ANNUAL COST
      SEGMT 1
      $ AMOUNT?
                 5    RUN
6     YR ENDS?
                60    RUN
7     UNIT PRICE
      SEGMT 1
      % INCREASE?
                 4    RUN
8     YR ENDS?
                60    RUN
      CASH FLOWS
      C=COST,
      Y=YIELD,
      R=RETURN.

9A    C, Y, OR R?
      C             RUN
                  C
9B    YEAR?
                 0    RUN
9C    $ COST?
               500    RUN
9D    OK ?
                      RUN

      C, Y, OR R?
      C             RUN
                  C
      YEAR?
                15    RUN
      $ COST?
                80    RUN
      OK ?
                      RUN

10A   C, Y, OR R?
      R             RUN
                  R
10B   YEAR?
                35    RUN
10C   $ RETURN?
              2500    RUN
10D   OK ?
                      RUN

11A   C, Y, OR R?
      Y             RUN
                  Y
11B   YEAR?
                60    RUN
11C   NO. UNITS?
                25    RUN
11D   $ PRICE?
               250    RUN
11E   $ YIELD=
      $ 387359
11F   OK ?
                      RUN

12    C, Y, OR R?
      END           RUN
                  END
13    DONE?
                      RUN

      INVST PD=
      60
      MKT. INTRST=
      10.0
      INFLATION=
      3.0
      REINV. RATE=
      10.0
      ANN. COST
      1  $5 60
      PRICE INC.
      1  4.0% 60
      CASH FLOWS
      0  -$500
      15  -$125
      35  +$7035
      60  +$387359

      FV
      0  -$152241
      15  -$9111
      35   $76222
      60   $387359
      AC  -$23461

      FV COSTS
      -$184813
      FV RETURNS
      +$463581
      NFW= $278768

      PV
      0  -$500
      15  -$30
      35   $250
      60   $1272
      AC   -$77

      PV COSTS
      -$607
      PV RETURNS
      +$1522
      NPW= $915

      B/C= 2.507
      SEV= 918
      RRR
        = 11.70
      DONE
```

1 Key the years of investment length (e.g., for a 60–year investment, key the digits "6" and "0"), then R/S.

2 Key the desired interest rate (e.g., the digits "1" and "0" for 10%), then R/S.

3 Key the percentage of inflation desired, then R/S.

4 Key the percentage at which intermediate incomes can be reinvested, then R/S.

5 Key the dollar amount of the annual cost that occurs each year during Segment 1, then R/S. The annual cost must be constant over the entire length of Segment 1.

6 Key the digit for the year (or other time unit) at which you want the annual costs of Segment 1 to end. It may be any number from 1 to the number representing the length of the entire investment period (e.g., "10" for the 10th year). DO NOT enter a calendar year, such as "1985". Key R/S.

7 Key the percentage above the inflation rate by which you want unit prices to increase annually during Segment 1. Key R/S.

8 Key the digit for the year (or other time unit) at which you want the unit-price increase of Segment 1 to end. It may be any number from 1 to the number representing the length of the entire investment period. Key R/S.

9A Key C for a cost, then R/S.

9B Key the year in which the cost occurs, then R/S. (Remember that the year must be entered in the framework of the investment period; e.g., year "45" of a 60-year investment, NOT the calendar year.)

9C Key the dollar amount, then R/S. (Enter the amount in today's dollars; ECON will use the entered inflation rate to convert to future dollars.)

9D If the sequence is correct, key R/S and proceed. If the sequence is incorrect, key NO, then R/S, and reenter the CASH FLOWS sequence for the cost.

Repeat the CASH FLOWS sequence for other cost cash flows.

10A Key R for a return, the R/S.

10B Key the year in which the return occurs, then R/S.

10C Key the dollar return, then R/S.

10D If the sequence is correct, key R/S and proceed. If the sequence is incorrect, key NO, then R/S, and reenter the CASH FLOWS sequence for the return.

11A Key Y for a production yield, then R/S.

11B Key the year in which the yield occurs, then R/S.

11C Key the expected number of units, then R/S. (Be sure the units match those used for price per unit.)

11D Key price per unit, then R/S. (Enter the price per unit in today's terms. ECON will convert it into future price.)

11E ECON will display the total dollar amount generated after incorporating inflation, unit-price increase, and the elapsed time from the start of the investment period to the time of the yield.

11F If the sequence is correct, key R/S and proceed. If the sequence is incorrect, key NO, then R/S, and reenter the CASH FLOWS sequence for the yield.

12 When all cash flows have been entered, respond to C, Y, OR R? with END.

13 Key R/S if all cash flows have been entered. Key NO, then R/S if you have omitted a cash flow. (ECON will recycle the C, Y, OR R? sequence for as many cash flows as you wish and will incorporate all entries into the analysis.) Be alert when checking output, as ECON cannot sort entries into consecutive years.

You have finished Example 1. Sit back and let the calculator work. Some calculations are long; ECON pauses for a short time as it processes cash flows and for a particularly long time as it processes annual-cost cash flows. Don't be tempted to turn off the calculator before it beeps and displays DONE.

ECON Example 2: A More Complex Problem

The following example is an analysis of another 60-year forestry investment. It explains program features not shown in Example 1. The annotated numbers call attention to special features.

```
                XEQ "ECON"
    LENGTH OF
    INVST PD?
                 60    RUN
1   INTRST RATE?
                8.5    RUN
    RATE OF
    INFLATION?
                4.0    RUN
2   RATE OF
    REINVST.?
               10.0    RUN
    ANNUAL COST
    SEGMT 1
    $ AMOUNT?
                 10    RUN
    YR ENDS?
                 30    RUN
3   ANNUAL COST
    SEGMT 2
    $ AMOUNT?
                  5    RUN
    YR ENDS?
                 50    RUN
    UNIT PRICE
    SEGMT 1
    % INCREASE?
                  3    RUN
    YR ENDS?
                 10    RUN
    UNIT PRICE
    SEGMT 2
    % INCREASE?
                  2    RUN
    YR ENDS?
                 20    RUN
4   UNIT PRICE
    SEGMT 3
    % INCREASE?
                  1    RUN
    YR ENDS?
                 30    RUN
    CASH FLOWS
    C=COST,
    Y=YIELD,
    R=RETURN.

    C, Y, OR R?
    C                 RUN
                  C
    YEAR?
                  0    RUN
    $ COST?
                300    RUN
    OK ?
                       RUN

    C, Y, OR R?
    C                 RUN
                  C
    YEAR?
                 10    RUN
    $ COST?
                 70    RUN
    OK ?
                       RUN

    C, Y, OR R?
    Y                 RUN
                  Y
    YEAR?
                 30    RUN
    NO. UNITS?
                 10    RUN
    $ PRICE?
                250    RUN
5   $ YIELD=
    $ 14673
    OK ?
                       RUN

6   C, Y, OR R?
    C                 RUN
                  C
    YEAR?
                 30    RUN
    $ COST?
               1441    RUN
    OK ?
                       RUN

    C, Y, OR R?
    Y                 RUN
                  Y
    YEAR?
                 40    RUN
    NO. UNITS?
                 12    RUN
    $ PRICE?
                250    RUN
    $ YIELD=
    $ 28791
    OK ?
                       RUN

    C, Y, OR R?
    Y                 RUN
                  Y
    YEAR?
                 60    RUN
    NO. UNITS?
                 60    RUN
    $ PRICE?
                300    RUN
    $ YIELD=
    $ 461851
    OK ?
                       RUN

    C, Y, OR R?

    END               RUN
                  END
    DONE?
                       RUN

    INVST PD=
    60
    MKT. INTRST=
    8.5
    INFLATION=
    4.0
    REINV. RATE=
    10.0
7   ANN. COST
    1  $10 30
    ANN. COST
    2  $5 60
    PRICE INC.
    1  3.0% 10
    PRICE INC.
    2  2.0% 20
8   PRICE INC.
    3  1.0% 60
    CASH FLOWS
    0  -$300
9   10  -$104
    30  +$9999
    40  +$28791
    60  +$461851
```

```
     FV                    +$724603              PV COSTS
     0  -$40078            NFW= $651957          -$544
     10  -$6145                                   PV RETURNS
     30   $115571                                 +$5424
     40   $147181          PV                     NPW= $4880
     60   $461851          0  -$300
10   AC  -$26423           10  -$46              B/C= 9.974
                           30   $865         11  SEV= 4917
     FV COSTS              40   $1102        12  RRR
     -$72646               60   $3457             = 13.00
     FV RETURNS            AC   -$198            DONE
```

1 Note that interest rates accurate to the nearest 0.1% are accepted.

2 Reinvestment rates may differ from interest rates. You may enter any reinvestment strategy that you would like to examine.

3 Annual costs may be specified for two segments of an investment period. The program prompts for Segment 2 only if the response to YR ENDS? is less than the length of the entire period. ECON forces the end of the second segment to coincide with the end of the investment period. Here Segment 2 was entered to end at 50, but the program output correctly shows it to end at 60 (see input echo, number 7, second annual cost entry).

4 Unit-price increases can be entered for three segments. ECON forces the end of the final segment to coincide with the end of the investment period (compare input and output data for Segment 3 unit price).

5 The $ YIELD is a function of the rate of unit-price increase, the appropriate price-increase period, timing of the activity, inflation rate, volume yield, and unit price. Here, unit prices increase 3% above inflation for 10 years, 2% for 10 years, and 1% for 30 years. The inflated price at year 30 is then:

$$\$250\ \{[(1.04)(1.03)]^{10}\ [(1.04)(1.02)]^{10}\ [(1.04)(1.01)]^{10}\} = \$1{,}467.33,$$

making the final $ YIELD = $14,673.

6 A cost in year 30 is entered separately to illustrate how ECON processes net cash flows in years with multiple entries. Note that in the cash-flows section only the net cash flow for year 30 appears.

7 Annual costs are summarized in the format: segment number, $ amount, year segment ends. Here, Segment 1, from time 0 to time 30, has $10 annual costs and Segment 2, from time 30 to time 60, has $5 annual costs.

8 Unit-price increases are summarized in the format: segment number, % amount, year segment ends. Here, the Segment 3 increase of 1% runs from time 20 to time 60.

9 Cash flows are summarized in the format: year of cash flow, $ amount of cash flow in year of occurrence. The $70 cost (current dollars) is compounded for 10 years at 4% inflation and rounded to get the -$104 cash flow shown here.

10 Cash flows do not contain annual costs, which are handled and summarized separately to enable you to see their effect on the financial results.

11 Soil expectation value (SEV) is the net present value of an infinite series of investments identical to the one being evaluated. Each investment period is implemented sequentially with the same activities and assumptions. In all investment periods, inflation is assumed to accumulate exactly as in the first (i.e., it does not accumulate indefinitely).

12 Realizable Rate of Return (RRR) reflects the assumption that all intermediate incomes (in this example, incomes from thinnings in years 30 and 40) are reinvested elsewhere at the stated reinvestment rate.

ECON Example 3: Error Recovery

The annotated numbers in this example call attention to information-entry errors and different methods of recovery. (For program error messages, see Appendix, page 15.)

```
                    XEQ "ECON"
LENGTH OF
INVST PD?
                      60    RUN
INTRST RATE?
                   100.0    RUN
RATE OF
INFLATION?
                       3.0  RUN
RATE OF
REINVST.?
                    10.0    RUN
1   ANNUAL COST
    SEGMT 1
    $ AMOUNT?
                    XEQ "ECON"
    LENGTH OF
    INVST PD?
                      60    RUN
    INTRST RATE?
                    10.0    RUN
    RATE OF
    INFLATION?
                       3.0  RUN
    RATE OF
    REINVST.?
                    10.0    RUN
    ANNUAL COST
    SEGMT 1
    $ AMOUNT?
2                      5    CLX
                      10    RUN
    YR ENDS?
                      30    RUN
    ANNUAL COST
    SEGMT 2
    $ AMOUNT?
                       5    RUN
    YR ENDS?
                      60    RUN
    UNIT PRICE
    SEGMT 1
    % INCREASE?
                       2    RUN
    YR ENDS?
                      60    RUN
3   CASH FLOWS
    C=COST,
    Y=YIELD,
    R=RETURN.

    C, Y, OR R?
    C                       RUN
                          C
    YEAR?
                          0 RUN
    $ COST?
                        500 RUN
    OK ?
                            RUN
    C, Y, OR R?
    C                       RUN
                          C
    YEAR?
                         15 RUN
    $ COST?
                         80 RUN
    OK ?
                            RUN

    C, Y, OR R?
    R                       RUN
                          R
4   YEAR?
                      25000 RUN
    $ RETURN?
                         35 RUN
    OUT OF RANGE
                            CLX
                            RUN
    OK ?
    NO                      RUN

    C, Y, OR R?
    R                       RUN
                          R
    YEAR?
                         35 RUN
    $ RETURN?
                       2500 RUN
    OK ?
                            RUN
    C, Y, OR R?
    Z                       RUN
5                       Z
    DONE?
    NO                      RUN

    C, Y, OR R?
    Y                       RUN
                          Y
    YEAR?
                         60 RUN
    NO. UNITS?
                         45 RUN
    $ PRICE?
                        250 RUN
    $ YIELD=
    $ 217468
    OK ?
                            RUN


    C, Y, OR R?
                            RUN
6                       C, Y,
7   DONE?
    NO                      RUN

    C, Y, OR R?
    Y                       RUN
                          Y
    YEAR?
                         50 RUN
    NO. UNITS?
                         12 RUN
    $ PRICE?
                        200 RUN
    $ YIELD=
    $ 28319
    OK ?
                            RUN

    C, Y, OR R?
                            RUN
8                       C, Y,
    DONE?
9   ZES                     RUN
```

```
INVST PD=
60
MKT. INTRST=
10.0
INFLATION=
3.0
REINV. RATE=
10.0
ANN. COST
1  $10 30
ANN. COST
2  $5 60
PRICE INC.
1  2.0% 60
CASH FLOWS
0  -$500
15  -$125
35  +$7035
60  +$217468
50  +$28319

FV
0  -$152241
15  -$9111
35  $76222
60  $217468
50  $73452
AC  -$44056

FV COSTS
-$205408
FV RETURNS
+$367142
NFW= $161734
PV
0  -$500
15  -$30
35  $250
60  $714
50  $241
AC  -$145

PV COSTS
-$675
PV RETURNS
+$1205
NPW= $530

B/C= 1.786
SEV= 532
RRR
  = 11.07
DONE
```

1 At this point, you notice that earlier in the program you have entered 100% interest rather than 10%. You must start over by executing the ECON startup procedure (see page 7).

2 You have entered $5 instead of $10. Recover by depressing the correction key (←) and entering the correct digits. Key R/S.

3 After arriving at the CASH FLOWS section, you may correct input errors more easily by recycling the C, Y, OR R? sequence as shown next.

4 The $ return and year entries are reversed. ECON displays OUT OF RANGE if you have made this error or entered a year that is too large. To recover, wait for the calculator to exit PROGRAM mode. When the PRGM annunciator disappears, key GOLD, the correction key (←), and R/S. The calculator will prompt with OK? Key NO, then R/S. ECON returns to the C, Y, OR R? sequence. Reenter the cash flows sequence for R. ECON will return program operation to the top of the incorrectly entered transaction. (ECON will not recycle a sequence once you have responded affirmatively to OK? If you find an error entered in an earlier sequence, you will have to restart the program. CHECK INPUT CAREFULLY.)

5 Z is entered rather than C. ECON asks DONE? Respond NO. ECON returns to the C, Y, OR R? sequence.

6 Notice that C, Y, is printed after RUN. END wasn't typed in response to C, Y, OR R? to indicate completion of input. ECON prints C, Y, and continues processing.

7 The year–50 thinning information was forgotten. It can still be entered by responding NO to DONE? and by entering the proper data for the C, Y, OR R? sequence. ECON will make correct calculations even though it cannot print cash–flow activities in chronological order (year–60 data will appear before year–50 data).

8 END was omitted again. ECON prints C, Y, and continues processing.

9 You're finished, but you have typed Z instead of Y in YES. ECON is programmed to look for NO and will recycle the C, Y, OR R? sequence only if you type NO. With any other response, ECON continues processing.

Additional Sources of Information

CURTIS, C.O., G.W. CLENDENEN, and D.J. DeMARS. 1981. A new stand simulator for coast Douglas-fir: DFSIM user's guide. USDA Forest Service General Technical Report PNW-128. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

ELWOOD, N.E., and R.O. McMAHON. 1983. Forestry financial analysis I: An introduction for landowners. Extension Service Circular 1146, Oregon State University, Corvallis, Oregon 97331. 6 p. ($0.50.)

ELWOOD, N.E., and R.O. McMAHON. 1983. Forestry financial analysis II: Worksheets for how-to-do-it. Extension Service Circular 1147, Oregon State University, Corvallis, Oregon 97331. 32 p. ($2.00.)

ELWOOD, N.E., and R.O. McMAHON. 1983. Forestry financial analysis III: How to compare two (or more) investments. Extension Service Circular 1148, Oregon State University, Corvallis, Oregon 97331. 28 p. ($1.50.)

SCHALLAU, C.H., and M.E. WIRTH. 1980. Reinvestment rate and the analysis of forestry enterprises. Journal of Forestry 78(12):740-742.

Appendices

Programmer Notes

ECON was written in modules to facilitate checking and debugging. The main program handles part of the input, calculations, and output, and calls 11 subprograms to perform specific tasks. AC accepts annual costs; UP accepts unit-price increases; and CF accepts cash flows. PAC prints annual costs; PUP, unit-price increases; and PCF, cash flows. PCF calls RT to decompress the cash-flow storage form, as do FV and PV. FV computes future values of cash flows. CDA computes future and present values of annual costs. PT prints cost, return, and net amounts for both future and present values. PV computes present values of cash flows.

All prompts for inputs are displayed by one or more nonmoving lines, rather than by scrolling.

Flags used in ECON are: 15 (clear) and 16 (set) to interact with video displays (television sets) connected by HP-IL loops, 29 (clear) to eliminate commas in displays, 21 (set) to stop the calculator for displays when a printer is not used, and 55 (tested) to print a blank line if a printer is used.

Storage Format for Cash Flows

The storage format for cash flows permits a large number of flows, yet minimizes the space needed. A cost of $50 incurred in year 15 is represented as -50.015 in the data storage register. All cash flows are converted to an integer dollar amount by rounding. The year, divided by 1,000, is added to the dollar value. A positive sign is attached to returns, including yields converted to a dollar amount; a negative sign is attached to costs. This process is called compressing; decompressing is the reverse process that separates dollar amount and year into temporary storage registers.

The capacity of a data storage register is 10 digits. Because three digits are required after the decimal to represent the year, ECON will calculate correctly with values approaching $9,999,999. When values reach $10,000,000, ECON will round and truncate years to decades. Results in those instances will, therefore, be accurate only to the nearest decade. ECON has been programmed to stop calculating and abort the run when values equal or exceed $100,000,000. When dollar values are large, most problems can nonetheless be run simply by rescaling all values for cost, return, and number of units. For example, dividing by 10 would rescale from a 1-acre to a 0.1-acre basis. All subsequent dollar results must then be multiplied by 10 to return to an acre basis. The B/C and RRR proportions will be accurate as displayed.

Program Error Messages

Message	Meaning
TOO BIG	The calculator has encountered a number equal to or greater than 1.0×10^8. Because of the way in which dollar and year values are compressed and stored, results will be erroneous if numbers exceed this maximum. The calculator aborts the run, and there is no graceful means of recovery. However, you may be able to rescale the problem for a successful run as discussed in the previous section.
MAX NO. CASH FLOWS USED	The calculator has reached the maximum number of cash-flow entries permitted. It immediately begins processing the input data and printing out the results. If your problem had exactly 24 cash flows, the output will be correct. However, if your problem has more than 24 cash flows, you must restructure it for fewer cash-flow entries in order to use ECON.

Synopsis of Internal Operations

Set flags for video use, no commas, and stop for displays without printer.

Set counters to zero, constant to 1,000.

Request rotation length.

Request interest and inflation rates.

Request annual costs, calling AC for actual entry.

Request unit-price increases, calling UP for actual entry.

Change percentage rates to (1 + proportion) multiplier form.

Call CF to request and compress cash flows.

Print rotation, interest, and inflation rates.

Print annual costs, using PAC.

Print unit-price increases, using PUP.

Sum cash flows occurring during same year to produce a net value.

Print net cash flows, using PCF.

Compute future values of cash flows, using FV for computation, accumulation, and printing.

Call CDA to process annual costs, computing both future and present values.

Print future value of annual costs.

Print future value totals, using PT.

Compute present values of cash flows, using PV for computation, accumulation, and printing.

Print present value of annual costs.

Print present value totals, using PT.

Compute and print other economic criteria: B/C, SEV, RRR.

Stop.

Note: PCF, FV, and PV use RT to decompress cash flows.

Data Storage Registers

00	Temporary use
01	Number of cash flows
02	1,000 (time factor)
03-10	Temporary use
11	Rotation length
12	Market rate
13	Inflation rate
14	Reinvestment rate
15	Annual cost, time
16	Annual cost, time
17	Unit-price increase, time
18	Unit-price increase, time
19	Unit-price increase, time
20	Temporary
21–44	Cash flow, time
45	Future-value cost
46	Future-value return at market rate for NFV
47	Present-value cost
48	Present-value return
49	Future-value return at reinvestment rate for RRR

Program Listing

Program ECON

```
01♦LBL "ECON"
02 "COPYRIGHT 1985"
03 "ORE STATE UNIV"
04 "FOR RES LAB"
05 CF 15
06 SF 16
07 CF 29
08 SF 21
09 CLRG
10 1000
11 STO 02
12 FIX 0
13 "LENGTH OF"
14 AVIEW
15 "INVST PD?"
16 PROMPT
17 STO 11
18 FIX 1
19 "INTRST RATE?"
20 PROMPT
21 STO 12
22 "RATE OF"
23 AVIEW
24 "INFLATION?"
25 PROMPT
26 STO 13
27 "RATE OF"
28 AVIEW
29 "REINVST.?"
30 PROMPT
31 STO 14
```

Enter Annual Costs

```
32 FIX 0
33 1
34 STO 03
35 XEQ "AC"
36 STO 15
37 RCL 04
38 RCL 11
39 X<=Y?
40 GTO 04
41 2
42 STO 03
43 XEQ "AC"
44 STO 16
```

Enter Unit-price Increases

```
45♦LBL 04
46 1
47 STO 03
48 XEQ "UP"
49 STO 17
50 RCL 04
51 RCL 11
52 X<=Y?
53 GTO 06
54 2
55 STO 03
56 XEQ "UP"
57 STO 18
58 RCL 04
59 RCL 11
60 X<=Y?
61 GTO 06
62 3
63 STO 03
64 XEQ "UP"
65 STO 19
```

Change Interest and Inflation Rates to Multiplier Form

```
66♦LBL 06
67 12.014
68 STO 00
69♦LBL 07
70 RCL IND 00
71 100
72 /
73 1
74 +
75 STO IND 00
76 ISG 00
77 GTO 07
```

Enter Cash Flows

```
78 "CASH FLOWS"
79 AVIEW
80 "C=COST,"
81 AVIEW
82 "Y=YIELD,"
83 AVIEW
84 "R=RETURN."
85 AVIEW
86 20
87 STO 01
88 XEQ "CF"
89 RCL 01
90 X=0?
91 GTO 28
```

Print Rates

```
92 FIX 0
93 FS? 55
94 ADV
95 "INVST PD="
96 AVIEW
97 CLA
98 ARCL 11
99 AVIEW
100 FIX 1
101 "MKT. INTRST="
102 AVIEW
103 CLA
104 RCL 12
105 1
106 -
107 100
108 *
109 ARCL X
110 AVIEW
111 "INFLATION="
112 AVIEW
113 CLA
114 RCL 13
115 1
116 -
117 100
118 *
119 ARCL X
120 AVIEW
121 "REINV. RATE="
122 AVIEW
123 CLA
124 RCL 14
125 1
126 -
127 100
128 *
129 ARCL X
130 AVIEW
```

Print Annual Costs

```
131 FIX 0
132 1
133 STO 03
134 15
135 STO 04
136 XEQ "PAC"
137 RCL 11
138 X<=Y?
139 GTO 14
140 2
141 STO 03
142 16
143 STO 04
144 XEQ "PAC"
```

Print Unit-price Increases

```
145♦LBL 14
146 1
147 STO 03
148 17
149 STO 04
150 XEQ "PUP"
151 RCL 11
152 X<=Y?
153 GTO 16
154 2
155 STO 03
156 18
157 STO 04
158 XEQ "PUP"
159 RCL 11
160 X<=Y?
161 GTO 16
162 3
163 STO 03
164 19
165 STO 04
166 XEQ "PUP"
```

Compute Net Cash Flows

```
167♦LBL 16
168 21
169 STO 00
170 RCL 01
171 X=Y?
172 GTO 22
173♦LBL 17
174 RCL IND 00
175 FRC
176 ABS
177 STO 03
178 RCL 01
179 RCL 02
180 /
181 RCL 00
182 +
183 1
184 +
185 STO 04
186♦LBL 18
187 RCL IND 04
188 X=0?
189 GTO 19
190 FRC
191 ABS
192 RCL 03
```

```
193 X≠Y?
194 GTO 19
195 RCL IND 04
196 INT
197 RCL IND 00
198 INT
199 +
200 STO 05
201 SIGN
202 RCL 03
203 *
204 RCL 05
205 +
206 STO IND 00
207 0
208 STO IND 04
209♦LBL 19
210 ISG 04
211 GTO 18
212 RCL 00
213 44
214 X=Y?
215 GTO 22
216 1
217 ST+ 00
218 RCL 01
219 RCL 02
220 /
221 RCL 00
222 +
223 STO 04
224♦LBL 20
225 RCL IND 04
226 X≠0?
227 GTO 21
228 ISG 04
229 GTO 20
230 1
231 ST- 00
232 GTO 22
233♦LBL 21
234 STO IND 00
235 RCL 00
236 INT
237 RCL 04
238 INT
239 X=Y?
240 GTO 17
241 0
242 STO IND 04
243 GTO 17
```

Print Net Cash Flows

```
244♦LBL 22
245 RCL 00
246 STO 01
247 RCL 02
248 /
249 21
250 +
251 STO 03
252 STO 20
253 "CASH FLOWS"
254 AVIEW
255♦LBL 23
256 XEQ "PCF"
257 ISG 03
258 GTO 23
```

Compute Future Values

```
259 0
260 STO 09
261 STO 10
262 STO 49
263 RCL 20
264 STO 03
265 FS? 55
266 ADV
267 "FV"
268 AVIEW
269 XEQ "FV"
270 XEQ "CDA"
271 "AC  -$"
272 ARCL 08
273 AVIEW
274 45
275 STO 04
276 46
277 STO 05
278 FS? 55
279 ADV
280 "FV "
281 ASTO 06
282 "NFW= "
283 ASTO 00
284 XEQ "PT"
```

Compute Present Values

```
285 0
286 STO 09
287 STO 10
288 RCL 20
289 STO 03
290 FS? 55
291 ADV
292 "PV"
293 AVIEW
294 XEQ "PV"
295 RCL 07
296 STO 08
297 "AC   -$"
298 ARCL 08
299 AVIEW
300 PSE
301 47
302 STO 04
303 48
304 STO 05
305 FS? 55
306 ADV
307 "PV "
308 ASTO 06
309 "NPW= "
310 ASTO 00
311 XEQ "PT"
```

Compute Other Economic Criteria

```
312 FS? 55
313 ADV
314 FIX 3
315 "B/C= "
316 RCL 48
317 RCL 47
318 X=0?
319 GTO 28
320 /
321 ARCL X
322 AVIEW
323 FIX 0
324 "SEV= "
325 RCL 48
326 RCL 47
327 -
328 RCL 12
329 RCL 11
330 Y↑X
331 STO 00
332 1
333 -
334 /
335 RCL 00
336 *
337 ARCL X
338 AVIEW
339 FIX 2
340 "RRR"
341 AVIEW
342 RCL 49
343 RCL 47
344 /
345 RCL 11
346 1/X
347 Y↑X
348 1
349 -
350 100
351 *
352 "  = "
353 ARCL X
354 AVIEW
355♦LBL 28
356 "DONE"
357 BEEP
358 AVIEW
359 RTN
```

Subroutine AC for Entering Annual Costs

```
360♦LBL "AC"
361 "ANNUAL COST"
362 AVIEW
363 "SEGMT "
364 ARCL 03
365 AVIEW
366 "$ AMOUNT?"
367 PROMPT
368 .5
369 +
370 INT
371 STO 05
372 "YR ENDS?"
373 PROMPT
374 STO 04
375 RCL 03
376 2
377 X≠Y?
378 GTO 32
379 RCL 11
380 STO 04
381♦LBL 32
382 RCL 05
383 RCL 04
384 RCL 02
385 /
386 +
387 RTN
```

Subroutine UP for Entering Unit-price Increases

```
388♦LBL "UP"
389 "UNIT PRICE"
390 AVIEW
391 "SEGMT "
392 ARCL 03
393 AVIEW
394 "% INCREASE?"
395 PROMPT
396 10
397 *
398 STO 05
399 "YR ENDS?"
400 PROMPT
401 STO 04
402 RCL 03
403 3
404 X≠Y?
```

```
405 GTO 35
406 RCL 11
407 STO 04
408♦LBL 35
409 RCL 05
410 RCL 04
411 RCL 02
412 /
413 +
414 RTN
```

Subroutine CF for Entering and Compressing Cash Flows

```
415♦LBL "CF"
416♦LBL 36
417 44
418 RCL 01
419 X<Y?
420 GTO 37
421 "MAX. NO. CASH"
422 AVIEW
423 "FLOWS USED"
424 AVIEW
425 RTN
426♦LBL 37
427 FS? 55
428 ADV
429 "C, Y, OR R?"
430 AON
431 PROMPT
432 AOFF
433 ASTO Y
434 CLA
435 "        "
436 "├       "
437 ARCL Y
438 FS? 55
439 PRA
440 "C"
441 ASTO X
442 X=Y?
443 GTO 40
444 "Y"
445 ASTO X
446 X=Y?
447 GTO 42
448 "R"
449 ASTO X
450 X=Y?
451 GTO 52
452 "NO"
453 ASTO Y
454 "DONE?"
455 AON
456 PROMPT
457 AOFF
458 ASTO X
459 X=Y?
460 GTO 36
461 RTN
```

Enter Cost Cash Flow

```
462♦LBL 40
463 1
464 ST+ 01
465 "YEAR?"
466 PROMPT
467 STO 00
468 RCL 02
469 /
470 "$ COST?"
471 PROMPT
472 .5
473 +
474 INT
475 RCL 13
476 RCL 00
477 Y↑X
478 *
479 .5
480 +
481 INT
482 +
483 X>0?
484 CHS
485 STO IND 01
486 GTO 55
```

Enter Yield Cash Flow

```
487♦LBL 42
488 1
489 ST+ 01
490 "YEAR?"
491 PROMPT
492 STO 04
493 "NO. UNITS?"
494 PROMPT
495 STO 05
496 "$ PRICE?"
497 PROMPT
498 .5
499 +
500 INT
501 STO 06
502 0
503 STO 08
504 STO 09
505 RCL 17
506 FRC
507 RCL 02
508 *
509 STO 10
510 RCL 04
511 X>Y?
512 GTO 45
513 STO 07
514 GTO 48
515♦LBL 45
516 RCL 10
517 STO 07
518 RCL 18
519 FRC
520 RCL 02
521 *
522 STO 00
523 RCL 04
524 X>Y?
525 GTO 47
526 RCL 07
527 -
528 STO 08
529 GTO 48
530♦LBL 47
531 RCL 00
532 RCL 10
533 -
534 STO 08
535 RCL 04
536 RCL 00
537 -
538 STO 09
539♦LBL 48
540 1
541 STO 00
542 7.009
543 STO 10
544♦LBL 49
545 RCL 10
546 10
547 +
548 RCL IND X
549 INT
550 RCL 02
551 /
552 1
553 +
554 RCL 13
555 *
556 RCL IND 10
557 Y↑X
558 ST* 00
559 ISG 10
560 GTO 49
561 RCL 00
562 RCL 06
563 *
564 RCL 05
565 *
566 .5
567 +
568 INT
569 "$ YIELD="
570 AVIEW
571 PSE
572 "$ "
573 ARCL X
574 AVIEW
575 PSE
576 RCL 04
577 RCL 02
578 /
579 +
580 X<0?
581 CHS
582 STO IND 01
583 GTO 55
```

Enter Return Cash Flow

```
584♦LBL 52
585 1
586 ST+ 01
587 "YEAR?"
588 PROMPT
589 STO 00
590 RCL 02
591 /
592 "$ RETURN?"
593 PROMPT
594 .5
595 +
596 INT
597 RCL 13
598 RCL 00
599 Y↑X
600 *
601 .5
602 +
603 INT
604 +
605 X<0?
606 CHS
607 STO IND 01
```

Accept Cash Flow

```
608♦LBL 55
609 ABS
610 1.0 E8
611 X<=Y?
612 GTO 57
613 "OK ?"
614 AON
615 PROMPT
616 AOFF
617 ASTO X
618 "NO"
619 ASTO Y
620 X≠Y?
621 GTO 36
622 1
623 ST- 01
```

```
624 GTO 36
625♦LBL 57
626 "TOO BIG"
627 AVIEW
628 0
629 STO 01
630 RTN
```

Subroutine PAC for Printing Annual Costs

```
631♦LBL "PAC"
632 "ANN. COST"
633 AVIEW
634 CLA
635 ARCL 03
636 "⊢  $"
637 RCL IND 04
638 INT
639 ARCL X
640 "⊢ "
641 RCL IND 04
642 FRC
643 RCL 02
644 *
645 ARCL X
646 AVIEW
647 RTN
```

Subroutine PUP for Printing Unit-price Increases

```
648♦LBL "PUP"
649 "PRICE INC."
650 AVIEW
651 CLA
652 FIX 0
653 ARCL 03
654 "⊢  "
655 FIX 1
656 RCL IND 04
657 INT
658 10
659 /
660 ARCL X
661 "⊢% "
662 FIX 0
663 RCL IND 04
664 FRC
665 RCL 02
666 *
667 ARCL X
668 AVIEW
669 RTN
```

Subroutine PCF for Printing Cash Flow

```
670♦LBL "PCF"
671 FIX 0
672 CLA
673 XEQ "RT"
674 ARCL X
675 RCL 04
676 X<0?
677 "⊢  -$"
678 X>0?
679 "⊢  +$"
680 X=0?
681 "⊢   $"
682 ARCL 05
683 AVIEW
684 RTN
```

Subroutine RT for Decompressing Cash Flows

```
685♦LBL "RT"
686 RCL IND 03
687 STO 04
688 X<0?
689 CHS
690 ENTER↑
691 INT
692 STO 05
693 RDN
694 FRC
695 RCL 02
696 *
697 STO 06
698 RTN
```

Subroutine FV for Computing Future Values

```
699♦LBL "FV"
700♦LBL 63
701 XEQ "RT"
702 RCL 04
703 X=0?
704 RTN
705 X>0?
706 GTO 66
707 RCL 12
708 RCL 11
709 RCL 06
710 -
711 Y↑X
712 RCL 05
713 *
714 .5
715 +
716 INT
717 ST+ 09
718 CLA
719 ARCL 06
720 "⊢  -$"
721 ARCL X
722 AVIEW
723 ISG 03
724 GTO 63
725 RTN
726♦LBL 66
727 RCL 14
728 RCL 11
729 RCL 06
730 -
731 Y↑X
732 RCL 05
733 *
734 ST+ 49
735 RCL 12
736 RCL 11
737 RCL 06
738 -
739 Y↑X
740 RCL 05
741 *
742 .5
743 +
744 INT
745 ST+ 10
746 CLA
747 ARCL 06
748 "⊢   $"
749 ARCL X
750 AVIEW
751 ISG 03
752 GTO 63
753 RTN
```

Subroutine CDA for Compounding and Discounting Annual Costs

```
754♦LBL "CDA"
755 0
756 STO 03
757 STO 07
758 STO 08
759 RCL 15
760 INT
761 X=0?
762 GTO 74
763 STO 04
764 RCL 15
765 FRC
766 RCL 02
767 *
768 1
769 -
770 RCL 02
771 /
772 STO 03
773♦LBL 71
774 RCL 13
775 RCL 03
776 INT
777 STO 05
778 Y↑X
779 STO 06
780 RCL 12
781 RCL 11
782 RCL 05
783 -
784 Y↑X
785 *
786 STO 00
787 RCL 06
788 RCL 12
789 RCL 05
790 Y↑X
791 /
792 STO 06
793 RCL 04
794 RCL 00
795 *
796 ST+ 08
797 RCL 04
798 RCL 06
799 *
800 ST+ 07
801 ISG 03
802 GTO 71
803♦LBL 74
804 RCL 16
805 INT
806 X=0?
807 RTN
808 STO 04
809 RCL 03
810 FRC
811 RCL 02
812 *
813 RCL 11
814 1
815 -
816 X=Y?
817 RTN
818 RCL 02
819 /
820 RCL 15
821 FRC
822 RCL 02
823 *
```

```
824 +
825 STO 03
826 GTO 71
827 RTN
```

Subroutine PT for Printing Cost, Return, and Net Values

```
828♦LBL "PT"
829 CLA
830 ARCL 06
831 "⊢COSTS"
832 AVIEW
833 RCL 08
834 RCL 09
835 +
836 STO IND 04
837 CLA
838 "-$"
839 ARCL X
840 AVIEW
841 CLA
842 ARCL 06
843 "⊢RETURNS"
844 AVIEW
845 CLA
846 "+$"
847 ARCL 10
848 AVIEW
849 RCL 10
850 STO IND 05
851 RCL IND 04
852 -
853 CLA
854 ARCL 00
855 X<0?
856 "⊢-"
857 "⊢$"
858 ABS
859 ARCL X
860 AVIEW
861 RTN
```

Subroutine PV for Computing Present Values

```
862♦LBL "PV"
863♦LBL 79
864 XEQ "RT"
865 RCL 04
866 X=0?
867 RTN
868 RCL 12
869 RCL 06
870 Y↑X
871 1/X
872 RCL 05
873 *
874 .5
875 +
876 INT
877 RCL 04
878 X>0?
879 GTO 82
880 X<>Y
881 ST+ 09
882 CLA
883 ARCL 06
884 "⊢  -$"
885 ARCL X
886 AVIEW
887 ISG 03
888 GTO 79
889 RTN
890♦LBL 82
891 X<>Y
892 ST+ 10
893 CLA
894 ARCL 06
895 "⊢   $"
896 ARCL X
897 AVIEW
898 ISG 03
899 GTO 79
900 RTN
901 END
```

ELWOOD, N.E., and J.C. KINCAID. 1985. ECON: A SYSTEM FOR ECONOMIC ANALYSIS WITH A PROGRAMMABLE CALCULATOR. Forest Research Laboratory, Oregon State University, Corvallis. Special Publication 12. 20 p.

Instructions are given for using program ECON to analyze financial performance of forestry or nonforestry projects. Although it is written for the Hewlett-Packard 41-C or 41-CV calculator, the program listing can be translated to other languages. ECON calculates net present worth and net future worth, soil expectation value, benefit-cost ratio, and rate of return.

KEYWORDS: financial analysis, forest project analysis, programmable calculator.

ELWOOD, N.E., and J.C. KINCAID. 1985. ECON: A SYSTEM FOR ECONOMIC ANALYSIS WITH A PROGRAMMABLE CALCULATOR. Forest Research Laboratory, Oregon State University, Corvallis. Special Publication 12. 20 p.

Instructions are given for using program ECON to analyze financial performance of forestry or nonforestry projects. Although it is written for the Hewlett-Packard 41-C or 41-CV calculator, the program listing can be translated to other languages. ECON calculates net present worth and net future worth, soil expectation value, benefit-cost ratio, and rate of return.

KEYWORDS: financial analysis, forest project analysis, programmable calculator.

Forest Research Laboratory
College of Forestry
Oregon State University
Corvallis, OR 97331

Non-Profit Org.
U.S. Postage
PAID
Corvallis, OR 97331
Permit No. 200

Address Correction Requested